"DEVELOPMENT OF VALUE ADDED BISCUITS ENRICHED WITH VELDT GRAPE (*Cissus quadrangularis*) STEM POWDER"

ANKITA ADITYA

Enrollment Number - 2322229002048

Registration Number - 230020481030

Semester- 4

M.Sc in Applied Nutriton and Dietetics

A dissertation submitted in partial fulfillment

of the requirements of the degree of

Masters of Science

Under the guidance of

DR. MOUMITA DAS, ASSISTANT PROFESSOR & HEAD

DEPARTMENT OF APPLIED NUTRITION AND DIETETICS

SISTER NIVEDITA UNIVERSITY 09.06.2025

9.6.25

9.6.25

2025

SISTER NIVEDITA UNIVERSITY

CERTIFICATE FROM SUPERVISOR

This is to certify that the dissertation work entitled ***"Development of value-added biscuits enriched with Veldt grape (Cissus quadrangularis) stem powder"***, is submitted by **Ms.Ankita Aditya** (*Enrollment No.: 2322229002048*) for the partial fulfilment of the degree of **Masters of Science** in **Applied Nutrition and Dietetics** under **Sister Nivedita University**. The entire work, which is being presented, has been carried out sincerely and satisfactorily under my supervision and guidance.

This thesis is accepted as a valid and credible work in partial fulfillment of the requirements for the Master of Science in Applied Nutrition and Dietetics. It has been presented in a form deemed acceptable for academic submission toward the stated degree. However, this approval does not imply that the undersigned endorses every statement, opinion, or conclusion contained within; rather, it signifies approval solely for the academic purpose for which the thesis was submitted.

Moumita Das 9/6/25

Dr. Moumita Das
Assistant Professor and Head
Dept. of Applied Nutrition and Dietetics
Sister Nivedita University

DECLARATION BY THE STUDENT

I hereby declare that the work which is being presented in this dissertation entitled "***DEVELOPMENT OF VALUE ADDED BISCUITS ENRICHED WITH VELDT GRAPE (Cissus quadrangularis) STEM POWDER***" in partial fulfilment of the requirements for the award of the degree of Bachelors/**Masters**/Ph.D of **Science** in **Applied Nutrition and Dietetics** is an authentic record of my own work carried out during the period from **January 2025** to **May 2025** under the supervision of **Dr. Moumita Das** Department of Applied Nutrition and Dieteics, Sister Nivedita University.

I acknowledge that I have read and understood the UGC regulations, 2018 (*Promotion of Academic integrity and Prevention of Plagiarism in Higher Educational Institutions*).

I confirm that this dissertation has been checked for plagiarism using the plagiarism checking software Turnitin. At the end of the dissertation, a copy of the summary report demonstrating similarities in content and its potential source (if any), generated online using plagiarism checking software is enclosed. I herewith confirm that the dissertation has been less than 10% similarity according to the plagiarism checking software's report and meets the UGC Regulations as well as plagiarism rules of Sister Nivedita University.

I further declare that no portion of the dissertation or its data will be published without the Institute's or supervisor's permission. I have not previously applied for any other degree or award using the topics and findings described in my dissertations.

Ankita Aditya 09.06.25

(Signature of the students with Date)

Name of the Student: Ankita Aditya

Registration no. 230020481030

Department: Applied Nutrition and Dietetics

ACKNOWLEDGEMENT

I would like to obtain this opportunity to convey my sincere gratitude and respectful thanks to my dissertation supervisor, **Dr. Moumita Das**, Head of the Department, Department of Applied Nutrition and Dietetics, for giving me this opportunity to train under her direction and supervision. Her steady support, intellectual stimulation, skilled direction, and wonderfully helpful ideas and suggestions from beginning to end allowed me to gain an improved understanding of the subject. Her advice and directions helped me to put the dissertation forward and successfully finish it.

I also want to express my heartfelt gratitude to all of my esteemed faculties, Asst. Professor Ms. Asmita Bhattacharjee, Asst. Professor Mrs. Shreyasi Halder, Asst. Professor Dr. Arpita Banerjee, Asst. Professor Mrs. Trina Das, Asst. Professor Ms. Falah Ismail, Lecturer Mrs. Beepsa Basu, Lecturer Mr. Ranjit Bhowmick and Lab Instructor Mrs. Adrija Sengupta, for their constructive and valuable suggestions throughout my journey of this project.

My dissertation would not have been possible without the constant support and guidance of the entire management of the college.

Lastly, I am thankful to my fellow friends and my parents as they helped me whenever I needed it. The project would not have beem successful without their cooperation and input.

Table of Contents

Certificate from Supervisor I

Declaration By The Student II

Acknowledgement III

List of Tables V

List of Figures VI

List of Abbreviations VII

ABSTRACT……

Chapter 1 1

INTRODUCTION 1-3

Chapter 2 4

REVIEW OF LITERATURE 4-6

Chapter 3 7

AIM & Objectives 7

Chapter 4 8

MATERIALS AND METHODS 8-15

Chapter 5 16

RESULT 16-21

Chapter 6 22

DISCUSSION 22

Chapter 7 23

CONCLUSION 23

Chapter 8 24

REFERENCES 24

ANNEXURE–A 26

ANNEXURE–B

LIST OF TABLES

Table 1Formulation of biscuits with varying proportions of veldt grape stem powder.....9

Table 2 Percent yield of veldt grape stem powder.....16

Table 3 Proximate composition of biscuits with varying proportions of veldt grape stem powder.....17

Table 4 Mean scores of the sensory attributes of biscuits with varying proportions of veldt grape stem powder.....20

LIST OF FIGURES

Figure 1: Process of making veldt grape stem powder…… ……9

Figure 2: (A) Peeled veldt grape stem, (B) Dehydrated veldt grape and (C) Veldt grape stem powder……9

Figure 3: Bread preparation……10

Figure 4: Protein estimation standard curve 18

Figure 5: Wheat flour biscuits incorporated with varying proportions of veldt grape stem powder……19

LIST OF ABBREVIATIONS

A.A.C.C. : American Association of Cereal Chemists

ANOVA : Analysis of variance

A.O.A.C. : Association of Official Analytical Chemist

Conc. : Concentrated

℃ : Degree Celsius

EDTA : Ethylene tetraacetic acid

℉ : Farenheight

g : Gram

hrs : Hours

kg : Kilogram

min. : Minute

ml : Milliliter

N : Normality

No. : Number

% : Percentage

Temp. : Temperature

VSP : Veldt Grape Stem Powder

Wt : Weight

ABSTRACT

Cissus quadrangularis, commonly known as Veldt Grape or Hadjod, is a medicinal plant traditionally utilized for its anti-inflammatory, antioxidant, and bone-strengthening properties. However, there is limited empirical evidence on incorporating this plant into food products, particularly bakery items like biscuits.This study aimed to develop value-added biscuits enriched with *Cissus quadrangularis* stem powder and evaluate their nutritional, sensory, and physical characteristics. Biscuit formulations were prepared using varying levels of *Cissus quadrangularis* stem powder, alongside a control formulation. The enriched biscuits were analyzed for proximate composition, mineral content, antioxidant activity, and sensory acceptability by following standard protocols.The results indicated that the incorporation of *Cissus quadrangularis* significantly enhanced the nutritional profile of the biscuits, with the moisture, fat, protein, ash, crude fiber, carbohydrate, and calcium content being 32.82%, 2.38, 11.89, 1.56, 2.35, 49.01, and 230.31, respectively. Sensory analysis revealed that biscuits with up to 4% enrichment were well-accepted, with no major compromise in taste, texture, or overall appeal. The physical properties of the biscuits remained within acceptable commercial standards.The study demonstrates the feasibility of utilizing *Cissus quadrangularis* stem powder as a functional ingredient in bakery products, offering a novel approach to combining traditional medicinal knowledge with modern food innovation. These findings contribute to the growing interest in plant-based, health-oriented snack products and open opportunities for further research in clinical validation and large-scale product development.

- **Keywords-**

Cissus quadrangularis, Veldt grape, Hadjod stem, Medicinal plant, Health benefits, Fortification, Bakery item, Proximate analysis and Nutrititive value.

Chapter 1

INTRODUCTION

The notion that "food should be medicine, and medicine should be food," attributed to the ancient Greek physician Hippocrates, encapsulates an emerging trend in contemporary nutrition science: the utilization of everyday foods as instruments for health promotion and disease prevention. In recent years, the growing awareness of the relationship between diet and health has led to an increased global demand for functional foods—products that provide health benefits beyond their basic nutritional value. As lifestyle-related diseases such as obesity, diabetes, cardiovascular disorders, and digestive problems become more prevalent, there is a renewed focus on developing food products that not only meet nutritional needs but also contribute to the prevention and management of such conditions. Functional foods represent a key innovation in this regard, offering opportunities to enhance public health through everyday dietary practices. As consumers increasingly prioritize health, there is a discernible shift from synthetic supplements to natural, food-based alternatives. Within this framework, functional foods—those offering health benefits beyond basic nutrition—have garnered significant interest among researchers, food manufacturers, and consumers.

One underutilized yet highly promising medicinal plant for food-based applications is *Cissus quadrangularis*, also known as Veldt Grape, Hadjod, or Devil's Backbone. Indigenous to tropical regions of Asia and Africa, Cissus quadrangularis has a longstanding presence in Ayurvedic and folk medicine, traditionally utilized for treating bone fractures, joint inflammation, and gastrointestinal ailments. Scientific investigations have corroborated its pharmacological properties, including antioxidant, anti-inflammatory, lipid-lowering, and bone-regenerating effects. The plant's stem is particularly rich in bioactive compounds such as ascorbic acid, carotenoids, phenolics, flavonoids, calcium, and other phytochemicals that may offer significant health benefits when incorporated into the diet. [1]

The plant's distinctive bitter and slightly astringent flavor profile, coupled with its phytochemical-rich composition, presents hurdles for achieving favorable sensory acceptance

in food product development. Overcoming these challenges through strategic formulation and sensory evaluation optimization may open up new pathways for incorporating traditional medicinal ingredients into accessible, food-based delivery systems.

Despite its extensive medicinal potential, *Cissus quadrangularis* remains largely unexplored in the realm of food product development. Existing research predominantly focuses on its therapeutic application in supplement form—such as powders, capsules, or extracts—while scant attention has been directed towards integrating this plant into common food products like biscuits. This represents a clear research gap and a missed opportunity to transform a traditional medicinal plant into a functional food ingredient. [2]

Biscuits, in particular, present a promising avenue for functional food innovation due to their widespread consumption, affordability, ease of storage, and sensory appeal. Their simple and adaptable formulation renders them an ideal medium for incorporating functional ingredients such as dietary fibers, plant extracts, or medicinal powders. Consequently, biscuits can be strategically employed to enhance the nutritional profile of the diet while maintaining consumer satisfaction. This study not only introduces a novel application of a traditional medicinal plant but also contributes to the functional food industry by promoting the use of indigenous, health-promoting ingredients in common snack foods. If successful, such products may serve as dietary tools for enhancing nutritional intake, supporting public health, and bridging the gap between natural medicine and modern convenience foods. [3]

A review of current literature reveals that most studies on *Cissus quadrangularis* have focused on its pharmacological effects or its use in capsule or extract form within the nutraceutical industry.[4] Very limited work has been undertaken to explore its culinary incorporation into widely accepted food products, such as bakery items. This represents a clear research gap—one that this study seeks to address.This study endeavors to address this gap by developing value-added biscuits enriched with *Cissus quadrangularis* stem powder. The objective is to formulate biscuits using varying concentrations of the stem powder and evaluate their nutritional, sensory, and physical properties. By doing so, the study aims to assess the feasibility of incorporating *Cissus quadrangularis* into a shelf-stable, widely accepted bakery product that could deliver health benefits as part of a regular diet. [5]

The significance of this research lies in its dual impact: it enhances the nutritional value of a commonly consumed food product and introduces a novel application for a traditional

medicinal plant. [6] If successful, this approach could pave the way for broader application of plant-based bioactives in the food industry and contribute to the growing demand for functional snacks that promote holistic health.

This study aimed to develop and evaluate value-added biscuits enriched with *Cissus quadrangularis* stem powder. The primary objective was to assess the impact of incorporating varying concentrations of the stem powder on the nutritional quality, physical properties, and sensory acceptability of the biscuits. The intention was to identify an optimal enrichment level that balances health benefits with consumer preference.

By integrating *Cissus quadrangularis* into a widely accepted food product, this research contributes to the functional food innovation landscape, highlighting the potential of traditional medicinal plants in modern dietary applications. Additionally, it supports the broader public health goal of improving nutritional quality through accessible, plant-based food products that align with sustainable and culturally rooted food systems.

Chapter 2

REVIEW OF LITERATURE

In recent years, herbal medicine has experienced rapid growth, gaining popularity in both developing and developed nations due to its natural origins and fewer side effects. A thorough review was conducted to gather information on medicinal plants used to treat conditions such as arthritis, osteoporosis, and diabetes mellitus. Numerous traditional plant products have demonstrated potential in combating modern lifestyle diseases like arthritis, obesity, diabetes, and cardiovascular diseases.

The analysis of *Cissus quadrangularis* according to a 2010 study revealed the following chemical composition: 89.19% moisture, 6.12 ± 0.50% crude protein, 6.38 ± 0.32% crude lipid, 3.48 ± 0.03% crude fiber, 6.97 ± 0.70% ash, and 77.04% nitrogen-free extractives, with a calorific value of 1629.46 (on a dry basis). [7]

According to the study conducted on the year 2014, the product was prepared by blending rice flour and *cissus* powder at three different ratios such as 0.2: 3.8 (5+95g), 0.4: 3.6(10+90g) and 1:3 (25:7g). Chopped onion, grated carrot, chilli, curry leaves and coriander leaves are added to the flour to make dough. Then rotis are cooked for 5 to 6 minutes in the pan over a medium flame. [2]

In 2017, a well-researched study notes that *Cissus quadrangularis*, or Hadjod, is a plant common in India, particularly in tropical climates. Known also as Veldt Grape or Devil's Backbone, its stem is valued in Ayurveda for various medicinal uses, including as a tonic, digestive aid, and for treating conditions like eye problems, menstrual issues, asthma, and pain. It's also used in managing obesity, diabetes, metabolic syndrome, and other ailments. Furthermore, Hadjod stem powder can be incorporated into bread, enhancing its nutritional content with increased protein, fiber, and minerals. The addition of Hadjod stem powder up to 4% can improve the bread's sensory qualities and overall nutritional value. [3], [8]

An in-depth study was conducted in 2020 on *Cissus quadrangularis* to establish it as a great herbal remedy in Ayurvedic medicine, possessing high nutraceutical qualities. It has demonstrated efficacy in promoting bone repairment, regulating physiological processes, and

serving as a natural therapeutic option for various health concerns such as fractures, joint discomfort, hormonal dysregulation, and digestive issues. The integration of this plant into everyday dietary practices, as a "pathya ahara" or beneficial food, exemplifies the Ayurvedic principle of utilizing food as a medicinal modality. [4]

The study performed in 2021 explores the fortification of rice and flour with *Cissus quadrangularis* (CQ), or veldt grape, stem powder. The goal is to address osteoporosis and osteoarthritis, which are linked to calcium deficiency, by delivering essential minerals like calcium, magnesium, and phosphorus through a widely consumed food staple, particularly for populations with limited access to nutrient-dense diets. The fortification was performed using the vacuum impregnation method, in which the fortified rice flour with CQ powder contains 1.4g of calcium and 0.8g of magnesium. [9]

A 2024 study on *Cissus quadrangularis* claims that it's a pharmacologically versatile and multifunctional medicinal plant with well-documented efficacy in promoting bone healing, mitigating inflammation, addressing metabolic disorders, and supporting gastrointestinal health. This botanical exhibits significant potential as a nutraceutical and functional food ingredient, particularly in the management of bone-related conditions and diabetes. While its traditional use is well-established and contemporary research findings are promising, comprehensive clinical studies are warranted to fully validate the plant's safety and therapeutic efficacy in human populations. [10]

The study conducted in 2024 aimed to develop a healthy, trendy snack of South Africa using *Cissus quadrangularis* (locally known as Hadjod) and to increase awareness and acceptability of this indigenous medicinal plant among young adults. The researchers formulated an energy bite infused with 4g and 6g of the plant powder, which was low in fat and salt, and considered safe. The result was a creative way to reintroduce this traditional plant with nutritional benefits into a modern, youth-friendly diet. [11]

A study performed on 2024 in South Korea, investigated the incorporation of *Cissus quadrangularis* powder into Tteokgalbi, a traditional Korean meat-based dish, made by combining meat with a mixture of soy sauce, NaCl, white sugar, honey, garlic, ginger, onion, scallion, rice wine, pepper, sesame oil, sesame seed, and flour, shaped, refrigerated and pan-fried. Five formulations were evaluated: a control without additives, one with ascorbic acid, and three with increasing levels of CQ (1%, 2%, and 4%). The findings indicated that the addition of CQ enhanced the dish's antioxidant and antimicrobial properties, particularly at 1-

2% inclusion levels. However, higher concentrations resulted in undesirable effects, such as reduced moisture, tougher texture, and increased oxidation. Overall, the optimal balance between health benefits and sensory quality was achieved with 1-2% CQ supplementation. [12]

Cissus quadrangularis, a medicinal plant belonging to the Vitaceae family, is abundant in bioactive compounds but exhibits limited accessibility and shelf stability in its raw state. To enhance its availability, in 2025, a study formulated a dehydrated nutripowder and utilized it to develop three food products: Cissus quadrangularis idli powder, dhal powder, and soup mix. Sensory evaluation revealed the soup mix as the most preferred option in terms of flavor, texture, taste, and overall acceptability, followed by the idli powder and dhal powder. This suggests that Cissus quadrangularis can be effectively incorporated into convenient, shelf-stable forms to promote its health benefits year-round. [13]

Chapter 3

AIM

This research aimed to develop and evaluate value-added biscuits fortified with *Cissus quadrangularis* stem powder. The study assessed the nutritional composition, sensory characteristics, and physical properties of the enriched biscuits, with the goal of exploring the potential of this medicinal plant as a functional food ingredient.

OBJECTIVES

- To formulate biscuits incorporating varying levels of *Cissus quadrangularis* stem powder.
- To evaluate the nutritional profile of the enriched biscuits, including moisture, protein, fat, fiber, ash, carbohydrate.
- To conduct sensory evaluation to assess consumer acceptance in terms of taste, texture, appearance, and overall liking.
- To determine the optimal inclusion level of *Cissus quadrangularis* that balances nutritional benefits with sensory acceptability.
- To explore the feasibility of incorporating underutilized medicinal plants into commonly consumed food products as part of functional food innovation.

Chapter 4

MATERIALS AND METHODS

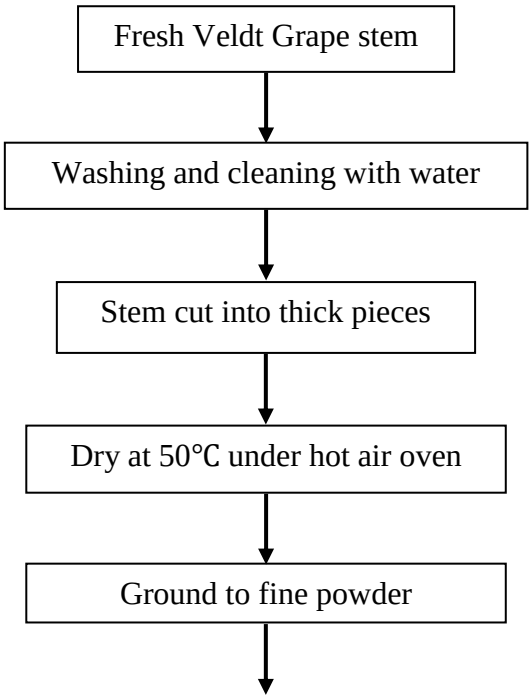
The materials and the methods opted to carry out the present research are presented below.

Materials

1. Collection of raw sample- Fresh and mature stems of Veldt grape (*Cissus quadrangularis*) were bought from a local nursery.
2. Ingredients- The ingredients which were used for making biscuits are as follows Whole wheat flour (100g), Jaggery (50g), Butter (25g), Baking Powder (1-2g),Milk (5ml), Salt (1g), Crushed Cardamom
3. Chemicals- Most of the chemicals used in the process was of analytical grade which were obtained from the Department of Applied Nutrition and Dietetics.
4. Processing and Analytical Equipments- The processing and analytical equipments included Hot Air Oven, OTG oven, Soxhlet appratus, Muffle furnace, Calorimeter and electronic balance(both rough and fine) for weight measurements, werew used from the Department of Applied Nutrition and Dietetics.

Methods

1. Preparation of Veldt Grape stem powder


Fresh Veldt Grape stem
Washing and cleaning with water
Stem cut into thick pieces
Dry at 50℃ under hot air oven
Ground to fine powder

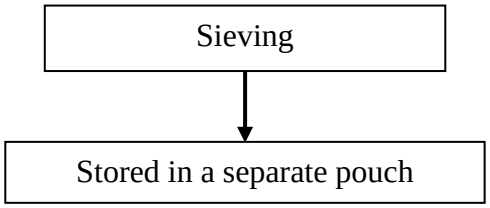


Figure 2: Process of making veldt grape stem powder [5]

A B C

Figure 2: (A) Peeled veldt grape stem, (B) Dehydrated veldt grape and (C) Veldt grape stem powder

2. Formulation of biscuits with varying proportions of veldt grape (*Cissus quadrangularis*) stems powder

Formualtion of biscuits incorporated with veldt grape stem powder is given in Table 1and the the recipe for the preparation of bread is outlined in the flowsheet no.2 The veldt grape stem was incorporated into whole wheat flour for the preparation of biscuits. The control sample($_{T0}$) of biscuit was prepared by only using whole wheat flour (100 per cent).

VARIATIONS	WHOLE WHEAT FLOUR (%)	VELDT GRAPE STEM POWDER (%)
T_0 (Control)	100	0
T_1	98	2
T_2	96	4
T_3	94	6

Table 1Formulation of biscuits with varying proportions of veldt grape stem powder [3]

The biscuit sample (T_1) was prepared by using 98 per cent of whole wheat flour and 2 per cent of veldt grape stem powder. The biscuit sample (T_2) was prepared by using 4 per cent veldt grape stem powder and 96 per cent of whole wheat flour. And the biscuit sample (T3) was prepared by using 94 per cent of whole wheat flour and 6 per cent of veldt grape stem powder.

3. Process of making Biscuits

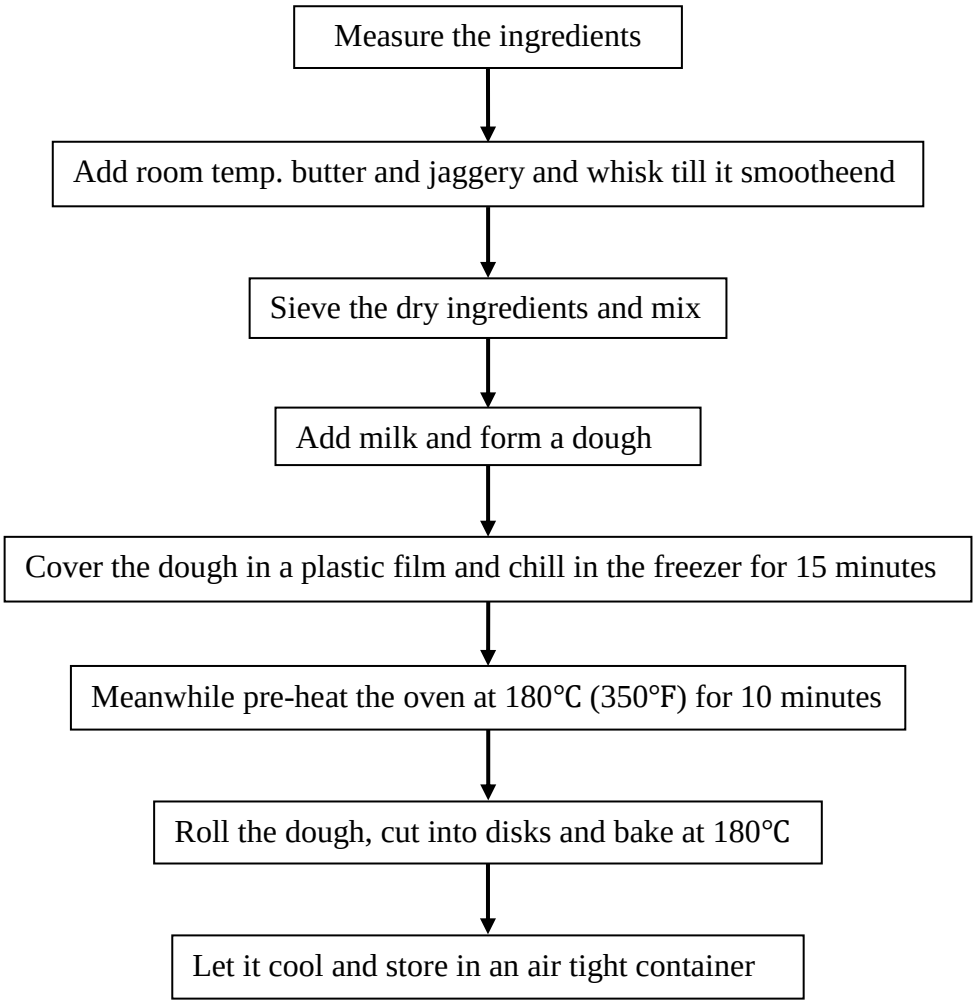

Measure the ingredients
Add room temp. butter and jaggery and whisk till it smootheend
Sieve the dry ingredients and mix
Add milk and form a dough
Cover the dough in a plastic film and chill in the freezer for 15 minutes
Meanwhile pre-heat the oven at 180℃ (350℉) for 10 minutes
Roll the dough, cut into disks and bake at 180℃
Let it cool and store in an air tight container

Figure 3: Bread preparation

The same process was followed to make the biscuits containing veldt grape. Addition of the ingredients along with the variation of veldt grape stem powder as given as T_0, T_1, T_2 and T_3.

4. Determination of Total Yield

Total yield was determined by calculating the percentage of powder obtained with respect to the quantity of veldt grape stem taken. [5]

$$\text{Yieldt of powder (\%)} = \frac{\text{Weight of powder}}{\text{Weight of stem}} \times 100$$

5. Proximate analysis of Biscuits

- Determination of Moisture content

Procedure

Approximately 5 grams of the sample were precisely measured and placed in pre-weighed petri dishes. The dishes containing the samples were then transferred to a hot air oven and dried at a temperature of 105°C for 4-5 hours. After drying, the oven-dried samples were cooled in a desiccator and weighed. This drying process was repeated until constant weights were obtained. The difference between the initial and final weights was calculated as the percentage moisture content of the sample.[16]

Calculation

$$\text{Moisture (\%)} = \frac{W1-W2}{W1} \times 100$$

Where, W_1 = weight of sample before drying.

W_2 = weight of sample after drying.

- Determination of Fat content

Reagent- Petroleum ether

Procedure

Five gram of ground sample were weighed into a cellulose thimble and placed in a Soxhlet extractor with 180 mL of petroleum ether. Extraction was carried out for 4–5 hours at a condensation rate of 240 drops per minute. After extraction, the solvent was transferred on a pre-weighed beaker and evaporated using a steam bath. The residue was cooled in a desiccator and weighed to determine the fat content based on the weight difference. [16]

Calculation

$$\text{Crude Fat (\%)} = \frac{W2-W1}{W0} \times 100$$

Where:

W_0= Initial sample weight

W_1 = Weight of empty evaporating dish

W_2 = Final weight of dish with extracted fat

- Determination of Protein content

The protein was estimated by Lowry's method.

Reagent

i. Reagent A: 2% sodium carbonate in 0.1N sodium hydroxide.
ii. Reagent B: 0.5% copper sulphate ($CuSO4.5H_2O$) in 1% potassium sodium tartarate. Prepare fresh by mixing stock solutions.
iii. Alkaline copper solution (Reagent C): Mix 50ml of reagent A and 1 mL of reagent B with 1ml of 1% Sodium Potssium Tartarate prior to use.
iv. Diluted Folin's reagent (Reagent D): Dilute 5ml of Folin-Ciocalteau reagent with 5ml of distilled water.
v. Standard: Dissolve 100mg BSA in 100ml of distilled water in a volumetric flask. Take 10mL of this stock standard and dilute to 50 mL in another flask for working standard solution.

Procedure

A series of standard solutions was prepared by pipetting varying volumes of the BSA working standard into labeled test tubes. Two tubes contained 1.0 ml of the unknown protein samples, and the total volume in all tubes was adjusted to 1.0 ml using distilled water. A blank was prepared with 1.0 ml of distilled water. Subsequently, Reagent C was added to each tube, and the contents were thoroughly mixed and allowed to stand at room temperature for 10 minutes. Reagent D was then rapidly added to each tube, and the tubes were incubated in the dark for 30 minutes. After incubation, the absorbance of each solution was measured at 660 nm using a colorimeter, with the blank serving as the reference. A standard curve was plotted, and the concentration of protein in the unknown samples was determined by comparing their absorbance values to the standard curve. [15]

- Determination of Ash content

Procedure

The empty crucible with lid was weighed. A 5-gram sample was measured and placed into the crucible. The sample was heated until it was fully charred and cooled, with no further fumes. The crucible was then transferred to a muffle furnace and heated at 550°C for approximately 4 hours until the sample turned grey. After this, the crucible was cooled in a desiccator and weighed repeatedly until the measurements were constant. Finally, the ash content was calculated by finding the difference between the initial and final weights of the sample. [16]

Calculation

$$\text{Ash (\%)} = \frac{\text{Final wt.} - \text{Initial wt.}}{\text{Weight of sample taken}} \times 100$$

- Determination of Crude fibre

Procedure

The crude fiber content was determined using the Weende's method. Specifically, a 2-gram sample of the air-dried, fat-free material was placed in a 600-mL beaker and digested with 200 mL of 1.25% H_2SO_4, boiled for 30 minutes at 100°C while periodically swirling the beaker. The residue was filtered through filter paper and washed with boiling water. The digestion process was then repeated using 200 mL of 1.25% NaOH for 30 minutes, followed by filtration using the same method. Afterward, the residue was transferred to a crucible, dried at 105°C until the weight remained constant, and then ignited in a muffle furnace at 550°C for 3 hours. Finally, the sample was cooled and weighed to determine the ash content.[14]

Calculation

$$\text{Crude Fibre (\%)} = \frac{W1 - W2}{\text{Wt.of sample taken}} \times 100$$

Where,

W_1= Weight of residue

W_2= Weight of ash

- Determination of Carbohydrate content

The carbohydrate content of the veldt grape biscuits was determined using differentiation method. [14]

Calculation

Carbohydrate (%) = 100-(Moisture+Fat+Protein+Ash+Crude fibre)

6. Determination calcium content

Reagents

i. EDTA solution- 0.74g EDTA,0.0047g Magnesium chloride ($MgCl_{2)}$ in 200ml distilled water

ii. Buffer (Ph10) solution- 0.34g Ammonium chloride (NH_4Cl), conc.Ammonium hydroxide (NH_3) in 5ml distilled water. It was prepared fresh.

iii. Eriochrome Black T (EBT) indicator- Mix 0.05g EBT in 10ml distilled water.

Procedure

The burette is cleaned thoroughly. Take about 200ml of the stock EDTA solution into a clean, dry beaker. Rinse the burette with 5ml of the solution for 3mins. The tip of the burette should be full before continuing with the titration and it should be free from air bubbles. Fill the burette completely upto '0' mark, clamp the burette and note the initial reading. Pipette out 5ml of sample in a conical flask and add 1ml of buffer into it. Then add 2-3 drops of EBT into the solution. The solution turned wine red in colour.Titrate the solution against EDTA and note the final reading.The end point is the colour changed from wine red to blue. The titartion was repeated thrice. [17]

Mg EBT (wine) + EDTA —> Mg EDTA + EBT (blue)

7. Sensory Analysis

The study employed a scientific sensory evaluation method to assess, analyze, and interpret the responses to the food product, which helped determine its quality, characteristics, and acceptability. The organoleptic attributes of the hadjod stem powder-based biscuits, including appearance, aroma, flavor, texture, taste, mouthfeel, aftertaste, and overall acceptability, were evaluated by a panel of 50 semi-trained members. The samples were scored using a 9-point hedonic scale proforma, where the judges were asked to meticulously record their ratings on the 9-point Hedonic scale, with corresponding descriptive terms ranging from "like extremely" to "dislike extremely".

8. Statistical Analysis

The sensory evaluation data were analyzed using appropriate statistical methods to identify the most preferred formulations. Specifically, analysis of variance was performed using standard ANOVA procedure to assess the significance of differences among the treatments at the $p < 0.05$ level.

Chapter 5

RESULT

For the present research, the prepared biscuits using different proportion of veldt grape stem powder was evaluated in proximate compositions and sensory attributes. The results are presented below.

1. Total yield percent

The per cent yield of hadjod stem powder was obtained from using hot air oven.

SERIAL NO.	SAMPLES	OBSERVATION
1	Weight of stem (g)	424
2	Loss on drying (g)	382
3	(%) Yield of stem powder	9.91

Table 2 Percent yield of veldt grape stem powder

The fresh stem of veldt grape was kept in hot air oven at 50℃ for 45hrs. The result obatained from Table 2 revealed that yield% of dried powder is 9.91g/100g of fresh stem of cisuss quadrangularis and loss on drying was 382/424g. This means 9.91% of the original fresh stem weight remained as dry powder after drying.

2. Proximate analysis of the biscuits prepared with veldt grape stem powder

To investigate the impact of incorporating varying amounts of veldt grape stem powder on the nutritional quality attributes of biscuits, it is crucial to assess the effects on the chemical composition, including moisture, protein, fat, carbohydrate, crude fiber, and ash content of the biscuit samples.

VARIATIONS	PROXIMATE COMPOSITION (g/100g)					
	MOISTURE	FAT	PROTEIN	ASH	CRUDE FIBRE	CARBOHYDRATE
T_0	32.50±0.34	2.10± 0.38	11.35±0.17	1.40± 0.06	1.28± 0.71	51.37±0.41
T_1	32.82±0.51	2.38± 1.50	11.89±0.40	1.56± 0.72	2.35± 1.20	49.01±0.32
T_2	32.16±0.20	2.52± 1.12	12.62±1.02	1.68± 0.14	2.41± 0.32	48.61±0.91
T_3	33.43±1.41	3.29± 0.63	13.96±0.42	1.82± 0.82	2.60± 1.52	44.90±0.63

Table 3 Proximate composition of biscuits with varying proportions of veldt grape stem powder

The Veldt grape stem powder (VGSP) was incorporated at different levels (T_1, T_2, T_3) into refined wheat flour for the preparation of biscuits. Differences were observed among the various treatments in terms of crude protein, crude fat, crude fibre, ash, and carbohydrate content.

The nutritive value of biscuits remained more or less similar to the control when 4 per cent of Veldt grape stem powder was incorporated. The sample with this level of VGSP (T_2) retained 32.16% moisture after baking. Although the incorporation of VGSP generally improves protein, fibre, and mineral content, the lower observed carbohydrate values are due to the analysis being conducted on a wet basis, which accounts for moisture. Thus, the inclusion of Veldt grape stem powder in biscuit formulations results in only slight variations in overall nutritional composition, with beneficial enrichment in specific nutrients.

This indicated that inclusion of processed Veldt grape stem powder at 2.38%, 2.52%, and 3.2 9% fat levels (T_1, T_2, T_3) into refined wheat flour significantly affected the proximate compos ition of the biscuit samples (T_1, T_2, T_3), which were found to be significantly different from t he control sample (T_0), where no VGSP was incorporated.

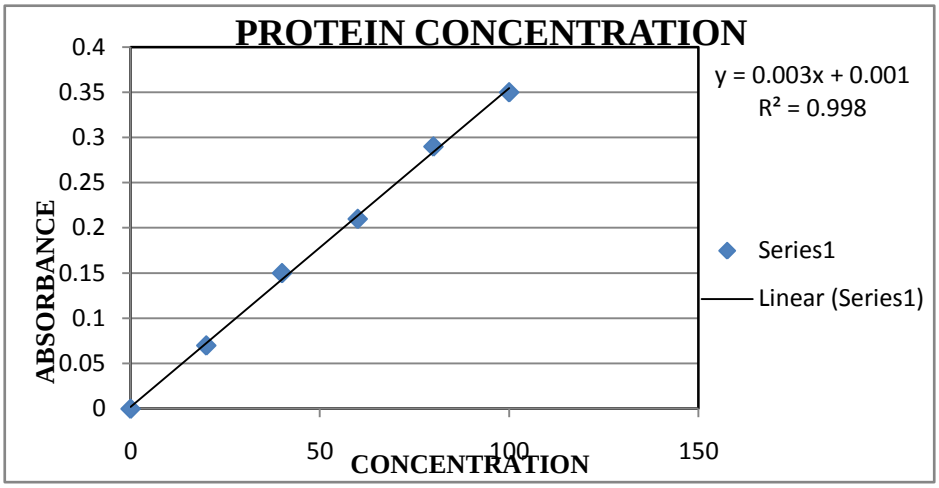


Figure 4: Protein estimation standard curve

As shown in the data, the protein content of biscuits increased from 11.35% in the control sample (T_0) to a significantly higher 13.96% in T_3, where the highest amount of VGSP was used. This suggests a notable increase in protein content due to VGSP incorporation. Treatment T_2 recorded 12.62% protein, and T_1 recorded 11.89%, both higher than the control, with T_3 showing the most significant increase. The addition of Veldt grape stem powder to wheat flour clearly enhanced the protein value from 11.35% to 13.96%.

Similarly, the crude fibre content of the biscuits increased progressively from 1.28% (T_0) to 2.60% (T_3), indicating a fiber enrichment with higher levels of VGSP inclusion. This enhancement contributes positively to the dietary fiber content of the biscuits.

The ash content, which reflects mineral presence, also showed a gradual increase: T_0 (1.40%), T_1 (1.56%), T_2 (1.68%), and T_3 (1.82%), demonstrating that VGSP contributed to improving the mineral profile of the biscuits.

Additionally, the carbohydrate content, calculated by difference, decreased with increasing VGSP levels. Carbohydrate percentages were 51.37% in T_0, 49.01% in T_1, 48.61% in T_2, and 44.90% in T_3. This inverse trend reflects the replacement of carbohydrate-rich wheat flour with more protein, fiber, and mineral-rich VGSP.

These findings confirm that the incorporation of Veldt grape stem powder into biscuit formulations not only improves nutritional parameters such as protein, fiber, and minerals but also modulates carbohydrate content, making the product more functionally beneficial.

3. Calcium content- Th calcium content of the biscuits made with varying proportion of veldt grape stem powder are as follow:

T_0= 32(mg/100g), T_1= 230.31(mg/100g), T2= 278.20(mg/100g), T_3= 287.19(mg/100g)

The findings indicate that the calcium content increases proportionally with the higher incorporation of Cissus quadrangularis stem powder across all treatment samples. Calcium is a crucial mineral for bone formation, as it constitutes 99% of the body's calcium reserves within the skeletal system. Extensive evidence suggests that adequate dietary calcium intake during early life stages can maximize peak bone mass and mitigate age-related bone loss, which is a significant risk factor for the development of osteoporosis due to insufficient intake of nutrients essential for bone health.

SAMPLE T_0

SAMPLE T_1

SAMPLE T_2

SAMPLE T_3

Figure 5: Wheat flour biscuits incorporated with varying proportions of veldt grape stem powder

4. Organoleptic Evaluation of the biscuits prepared with veldt grape stem powder

The sensory evaluation of biscuits incorporated with different levels of veldt grape stem powder (i.e. 2 per cent, 4 per cent, 6 per cent,) respectively were evaluated with respect to different sensory attributes like colour, flavour and overall acceptability using 9 point hedonic scale.

The result pertaining to the sensory characteristics of bread are presented in Table 4.

Variations	Attributes							
	Appearance	Aroma	Flavour	Texture	Taste	Mouth feel	Aftertaste	Overall Acceptibility
T_0	8.18±0.66	7.86± 0.67	7.74± 0.66	7.6±0.49	7.68± 0.47	7.52± 0.54	7.42±0.57	7.78±0.54
T_1	7.9±0.78	7.86± 0.67	7.84± 0.65	7.5±0.58	7.68± 0.62	7.48± 0.64	7.44±0.70	7.76±0.55
T_2	8.04±0.63	7.74± 0.63	7.36± 0.77	7.36± 0.52	7.24± 0.71	7.12± 0.71	7.12±0.77	7.4±0.60
T_3	7.42±0.81	7.4± 0.78	6.9± 0.78	6.9±0.67	6.52± 0.86	6.46± 0.67	6.44±0.70	6.7±0.73

Table 4 Mean scores of the sensory attributes of biscuits with varying proportions of veldt grape stem powder

It is evident from table 4 the result that control sample of bread was acceptable similar to 2 per cent veldt grape stem powder biscuit by the judges. The biscuit incorporated with veldt grape stem powder at 4percent increased the sensory scores as compared to other biscuit samples incorporated with different levels of veldt grape stem powder.

The sensory evaluation of the four biscuit samples revealed notable differences in various sensory characteristics due to changes in the formulation.

Appearance: Sample T_0 achieved the highest average score, indicating it was the most visually appealing to the assessors. T_2 and T_1 were close in visual appeal. Sample T_3 received the lowest score, suggesting a decrease in visual appeal with higher levels of the added ingredient.

Aroma: T_0 and T_1 both received top scores, indicating a pleasant and acceptable aroma. T_2 and T_3 had slightly lower scores, implying that higher ingredient quantities may have moderately affected the aroma.

Flavor: T_1 was the most favored for flavor, with T_0 slightly behind. However, a significant decline was observed in T_2 and T_3, suggesting that higher additive concentrations negatively impacted flavor perception.

Texture: A downward trend was noted from T_0 to T_3, indicating that the biscuits' texture became less appealing with elevated ingredient levels, potentially affecting their crispness or mouthfeel. Among the other samples, T_3 was perceived to be less crisp.

Taste: T_0 and T_1 received the highest taste ratings, signifying high acceptability. T_2 and T_3 had lower scores, as T_3 was baked with a slight herbal taste likely due to flavor changes from the added component.

Mouthfeel and Aftertaste: T_0 scored the highest in both mouthfeel and aftertaste, while T_3 scored the lowest, suggesting that higher treatment levels negatively impacted the overall sensory experience, potentially due to slight throat irritation observed in T_3.

Overall Acceptability: T_0 and T_1 received the highest overall acceptability scores, indicating strong consumer preference. T_2 and T_3 were less favored, correlating with the decline in other sensory attributes.

Among the biscuit samples, T_0 and T_1—likely the control and minimally treated formulations—were the most acceptable across all sensory parameters. In contrast, T_2 and T_3, which presumably contained higher levels of added ingredients such as Cissus quadrangularis, showed a decline in sensory quality.

Chapter 6

DISCUSSION

This study investigated the development of biscuits enriched with *Cissus quadrangularis* stem powder, evaluating their nutritional, sensory, and physical attributes. The results demonstrated that incorporating the stem powder at 2–4% levels improved the nutritional profile without significantly compromising sensory acceptability or physical integrity.

Physically, enriched biscuits exhibited reduced spread ratio and increased hardness, consistent with previous work done on 2010, who noted denser textures when fiber-rich ingredients like rice bran were added.[18] The darkened color observed with higher enrichment levels is also comparable to changes during botanical powder incorporation in bakery products.[5]

Sensory evaluation showed that 2–4% enrichment maintained good acceptability, while 6% resulted in bitterness and reduced consumer preference. Similar declines were reported when using amla powder [19] and with bitter gourd flour, highlighting the importance of optimal inclusion levels. [20]

This study addresses a notable research gap: while *Cissus quadrangularis* is well-studied pharmacologically, its incorporation into ready-to-eat functional foods is underexplored. By introducing it in biscuit form, this study adds new dimensions to dietary applications of traditional medicinal plants.

Limitations include a small-scale sensory panel and absence of shelf-life and clinical validation. Future work should focus on large-scale consumer testing, storage stability, and health impact studies.

Chapter 7

CONCLUSION

This research investigated the development and evaluation of value-added biscuits enriched with Cissus quadrangularis stem powder, focusing on their nutritional enhancement, sensory characteristics, and physical properties. The incorporation of this traditional medicinal plant into a commonly consumed bakery product presents a novel approach to functional food innovation. The control sample of bread was organoleptically acceptable, similar to bread containing 2% Cissus quadrangularis stem powder. The findings demonstrated that moderate enrichment levels, particularly up to 4%, significantly improved the nutritional value—specifically in dietary fiber and antioxidant activity—without adversely affecting consumer acceptability. The physical properties, such as spread ratio and texture, remained within acceptable limits, indicating that the addition of Cissus quadrangularis does not compromise the structural integrity of the biscuits. Sensory evaluations confirmed that the enriched biscuits were generally well-received, with only slight declines in acceptance at higher inclusion levels, likely due to the inherent bitterness of the phytochemical compounds.

The study successfully addressed a critical gap in current functional food research by introducing Cissus quadrangularis into a ready-to-eat product format. It offers a promising direction for future work in plant-based functional snack development. However, the study was limited to small-scale production and semi-trained sensory evaluation. Future research should include large-scale consumer trials, clinical validation of health benefits, and exploration of shelf life and commercial feasibility.

Chapter 8

REFERENCES

1) Temkar, S.G. and Jadhao, K.R. (2024). Veld Grape: An Unattended Medicinal Plant. *Food and Scientific Reports*, 5(7):19-24
2) Malathi A.N. (2014).Nutritive value of mangoravalli (Cissus quadrangularis) powderand its value addition.*Current Trends in Technology and Science*, (3):33-37.
3) Nawghare, C. G. (2017). Studies on utilization of hadjod (cissus quadrangularis) stem powder as a nutraceutical in bread (Doctoral dissertation, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani). http://krishikosh.egranth.ac.in/handle/1/5810033248
4) Deepasha Vyas, Sunita D Ram. Asthishrinkhala (Cissus quadrangularis L.) – Unlocking health with a power pack nutraceutical. *Ayurpharm Int J Ayur Alli Sci*. 2020, 9(5):63-65.
5) Karadbhajne, S. V., Kumbhare, V., & Bombaywala, M. A. (2014). Application of Cissus quadrangularis Linn. (Hadjor) in nutraceutical food (bakery) products. *International Journal of ChemTech Research*,6(4): 2263-2270
6) Kumar, D., Guna, R., Abbirami, E., Gayathri, N., Karthik, R., & Sivasudha, T. (2019). Anti-oxidant and Anti-inflammatory Properties of Stem and Root Extracts of Cissus quadrangularis (Veldt Grape). *Asian Journal of Engineering and Applied Technology*, 8(1), 15-19.
7) Veerabahu R.M. and Chinnamadasamy K. (2010). Nutritional and antinutritional evaluation of some unconventional wild edible plants.*Tropical and Subtropical Agroecosystems*, (12): 495-506.
8) Kelbore, T., Yilma, B., & Srinivasan, B. (2022). Value addition of Cissus quadrangularis stem powder in Ethiopian flat bread: Injera and its effect on Nutritional composition, Sensory attributes and Microbial load. *Journal of Food Science and Technology*, 59(4), 1450-1459.
9) Lakshmanan, D. K., Ravichandran, G., Elangovan, A., & Thilagar, S. (2021). Fortification of raw rice and rice flour using Cissus quadrangularis L. (veldt grape) stem powder to overcome osteoporosis and its associated skeletal complication through staple diet. *Journal of Food Biochemistry*, 45(10), e13918. https://doi.org/10.1111/jfbc.13918
10) Singh, S. P., Mukadam, S. S., Prakash, I., Sarkar, M., Singh, S., Elangovan, M., & Patil, L. P. (2024). Medicinal application and industrial utilization of Veldt grape (Cissus quadrangularis L.): A review. *Annals of Phytomedicine*, 13(2), 327-340. http://dx.doi.org/10.54085/ap.2024.13.2.32

11) Pal, I., Singh, V., Naicker, A., & Palmer, K. (2024). Product development with Cissus quadrangularis (HADJOD) to create awareness among young adults. *South African Journal of Botany*, 171, 719-725. https://doi.org/10.1016/j.sajb.2024.06.041

12) Lee, J. J., Lee, J., Choi, J. S., & Ha, J. H. (2024). Effects of Cissus quadrangularis L. powder on proximate composition, physicochemical and textural properties of Tteokgalbi. *Food Science of Animal Resources*, 44(3), 684. 10.5851/kosfa.2024.e11

13) Praneetha, S., Kousalya, R., Kamaleshwaran, N. K., Kalaivani, P., & Kamaraju, A. (2024). Value added products of veldt grape (Cissus quadrangularis) and their organoleptic evaluation. 10.29321/MAJ.10.001122

14) A.O.A.C. (1990). Official methods of analysis. Trends in Food Science and Technology. *Association of Official Analytical Chemists*, Washington DC, USA.

15) A.A.C.C. 2000. Approved method of the AACC. 10th ed., *American Association of Cereal Chemists*, INC. St. Paul, Minnesota, USA.

16) A.O.A.C. (2005).Official methods of analysis, Association of Official Analytical Chemists.

17) Zak, B., Epstein, E. M. A. N. U. E. L., & Baginski, E. S. (1975). Review of calcium methodologies. *Annals of Clinical & Laboratory Science*, *5*(3), 195-215.

18) Indrani, D., Rajiv, J., & Prabhasankar, P. (2010). Influence of fibre-rich ingredients on rheological characteristics and quality of baked products. *Food Quality and Preference*, 21(6), 704–708.

19) Kumar, A., Saini, C. S., & Sogi, D. S. (2010). Development and evaluation of functional biscuits enriched with amla (Emblica officinalis) powder. *Indian Food Industry Magazine*, 29, 42–45.

20) Mohammed, I., Ahmed, A. R., & Senge, B. (2012). Dough rheology and bread quality of wheat–chickpea flour blends. *Industrial Crops and Products*, 36(1), 196–202.

ANNEXURE–A

ORGANOLEPTIC EVALUATION

SENSORY SCORE CHART

Name of the Product: Biscuit

Name of Evaluator:

Samples	Sensory Attributes							
	Appearance	Aroma	Flavour	Texture	Taste	Mouth feel	Aftertaste	Overall Acceptibility
T_0								
T_1								
T_2								
T_3								

Remark if any:

Hedonic Rating Scale

9	Like extremely
8	Like very much
7	Like moderately
6	Like slightly
5	Neither Like nor dislike
4	Dislike slightly
3	Dislike moderately
2	Dislike very much
1	Dislike extremely

Date: Sign of the evaluator:

Ankita Aditya

DEVELOPMENT OF VALUE ADDED BISCUITS ENRICHED WITH VELDT GRAPE(Cissusquadrangularis)STEM POWDER.docx

My Files

My Files

University

DocumentDetails

SubmissionID

trn:oid:::17268:98849117

SubmissionDate

Jun2,2025,12:55AMGMT+5:30

Download Date

Jun2,2025,1:24AMGMT+5:30

FileName

DEVELOPMENTOFVALUEADDEDBISCUITSENRICHEDWITHVELDTGRAPE(Cissusquadrangular....docx

FileSize

673.8KB

17Pages

4,279Words

24,914Characters

4%OverallSimilarity

Thecombinedtotalofallmatches,includingoverlappingsources,foreachdatabase.

FilteredfromtheReport

Bibliography

MatchGroups

16NotCitedorQuoted4%
Matcheswithneitherin-textcitationnorquotationmarks

0MissingQuotations0%
Matchesthatarestillverysimilartosourcematerial

3MissingCitation0%
Matchesthathavequotationmarks,butnoin-textcitation

0CitedandQuoted0%
Matcheswithin-textcitationpresent,butnoquotationmarks

TopSources

3% Internetsources
3% Publications
4% Submittedworks(StudentPapers)

IntegrityFlags

0IntegrityFlagsforReview

Nosuspicioustextmanipulationsfound.

Oursystem'salgorithmslookdeeplyatadocumentforanyinconsistenciesthatwouldseti tapartfromanormalsubmission.Ifwenoticesomethingstrange,weflagit for you to review.

AFlagisnotnecessarilyanindicatorofaproblem.However,we'drecommendyoufocus your attention there for further review.

S. Sengupta
09.06.25.

Dept. of ...
SISTER N...
...ITA UNIVERSITY
DG-1/2, Action Area-1
New Town, ...olkata-700 156